



# BACC

## BALTEX Assessment for Climate Change in the Baltic Sea Region

### Process and Results

Gdynia, CLIMAR-III, 9. May 2008



Speaker:  
Hans von Storch,  
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## The Baltic Sea Catchment Assessment: BACC



An effort to establish which knowledge about anthropogenic climate change is available for the Baltic Sea catchment.

Working group BACC of GEWEX program BALTEX.

Approximately 80 scientist from 10 countries have documented and assessed the published knowledge.

Assessment has been accepted by intergovernmental HELCOM commission as a basis for its future deliberations.





# The purpose

of the BACC assessment is to provide the scientific community and the public with an assessment of ongoing and future climate change in the Baltic Sea region. This is done by reviewing published scientific knowledge about climate change in the Baltic Sea region.

An important element is the comparison with the historical past (until about 1800) to provide a framework for the severity and unusualness of the change.

Also changes in environmental systems, due to climate change, are assessed - such as hydrological regimes and ecosystems.

## Authors contributing to BACC

The BACC Project integrated available knowledge of historical, current and expected future climate change.

The unique feature of BACC was the combination of evidence on climate change and related impacts on marine, freshwater and terrestrial ecosystems in the Baltic Sea basin (catchment and water body).

The results have not been influenced by either political or special interests.

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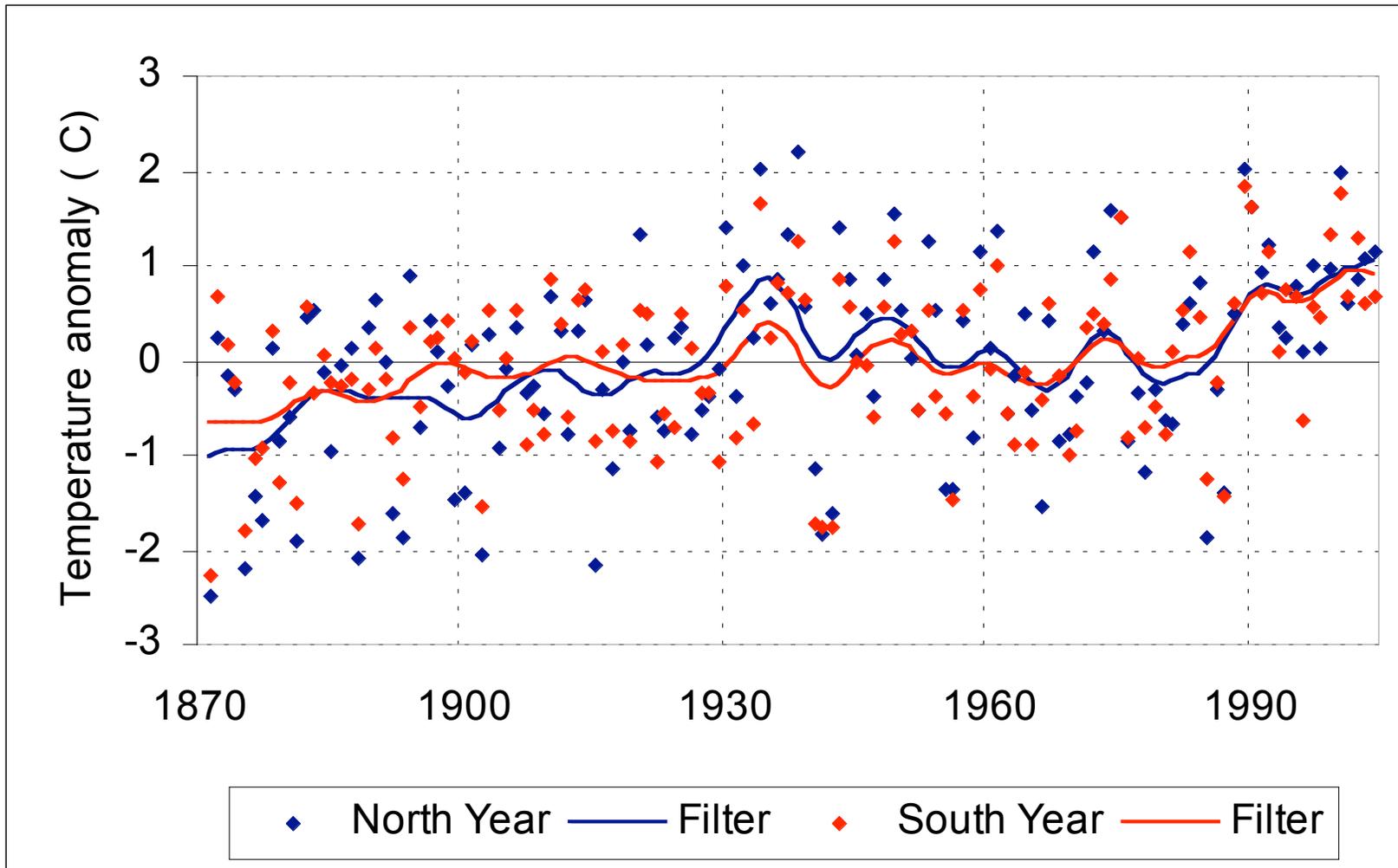
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# Past and current climate change

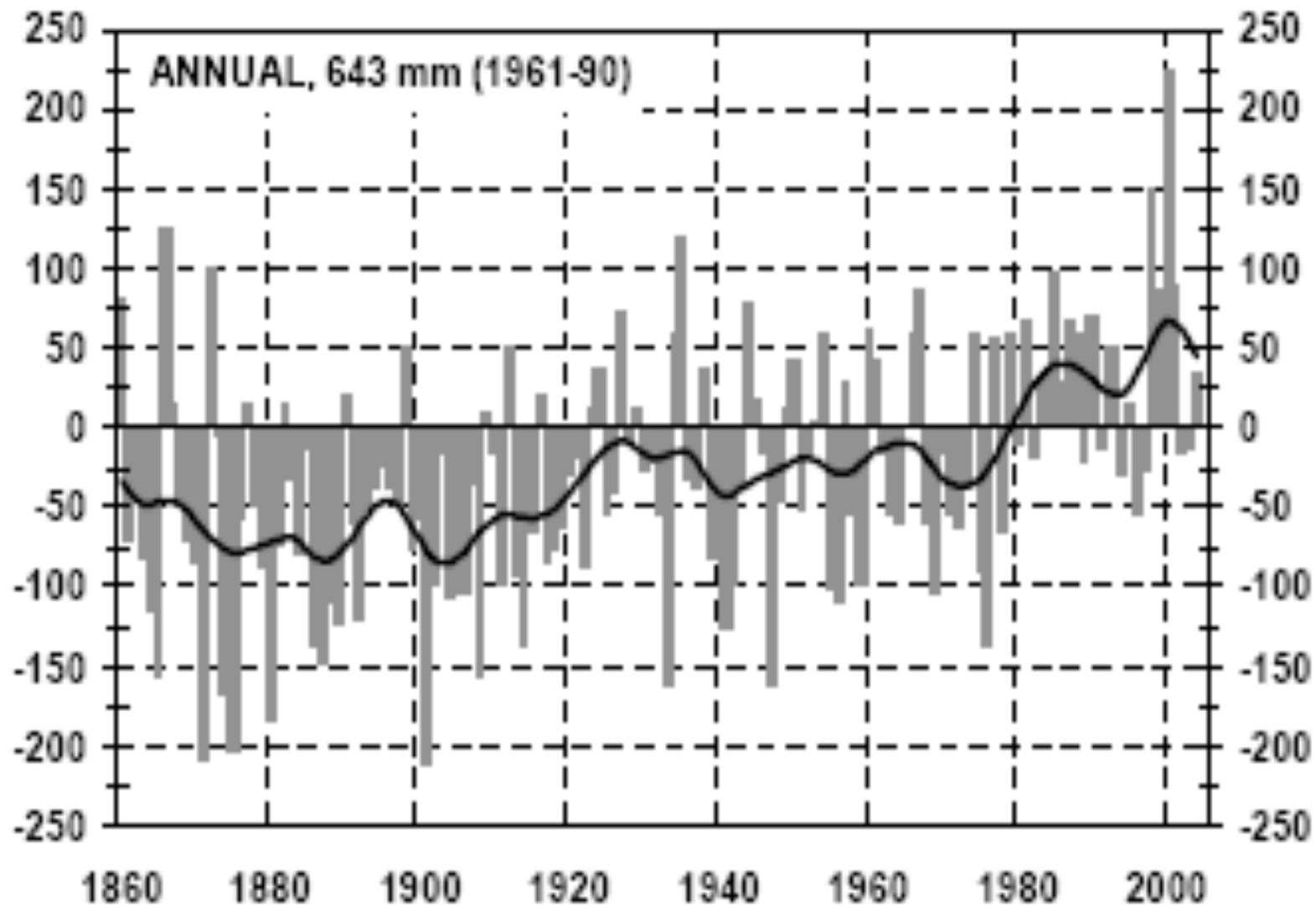


- Air temperature increased by 0.7 C over the past.
- Most pronounced warming in spring.
- Related observed changes in winter runoff, ice duration and snow.
- More precipitation in the 2nd half of the 20th century with major regional variations.
- No systematic change in windiness found.
- No clear long-term trends in Baltic Sea salinity.



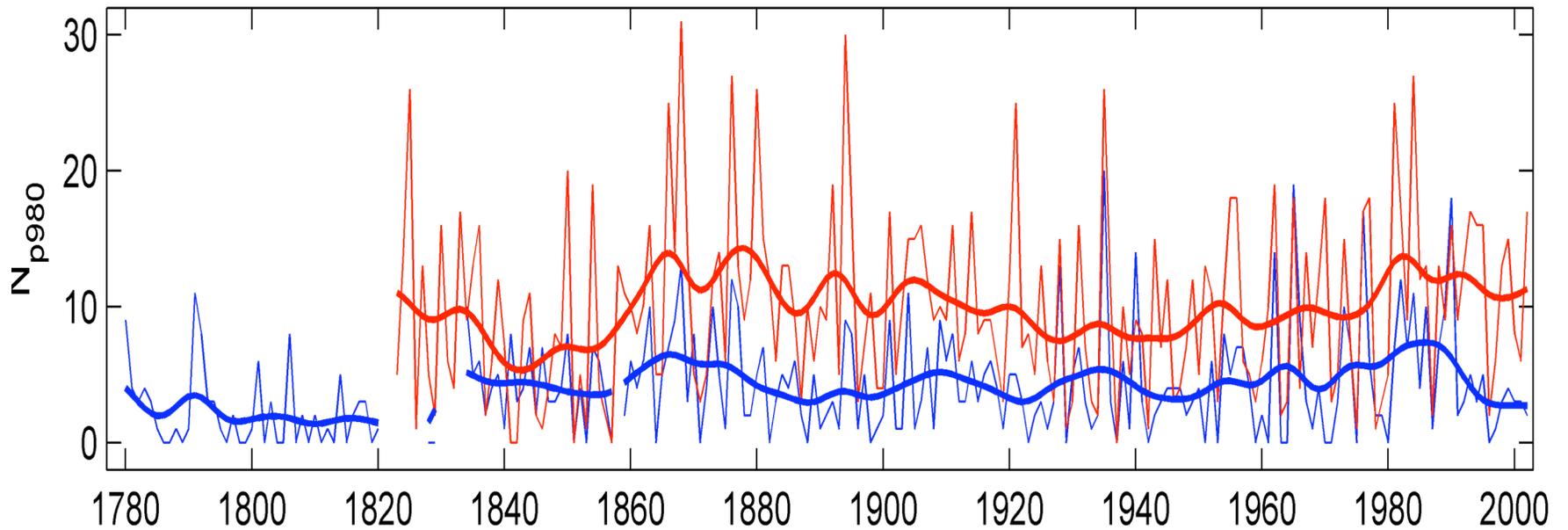
Note - time series has been „cleaned“; instrumental inhomogeneities and local effects (such as growing cities) have been taken out.

Air-temperature



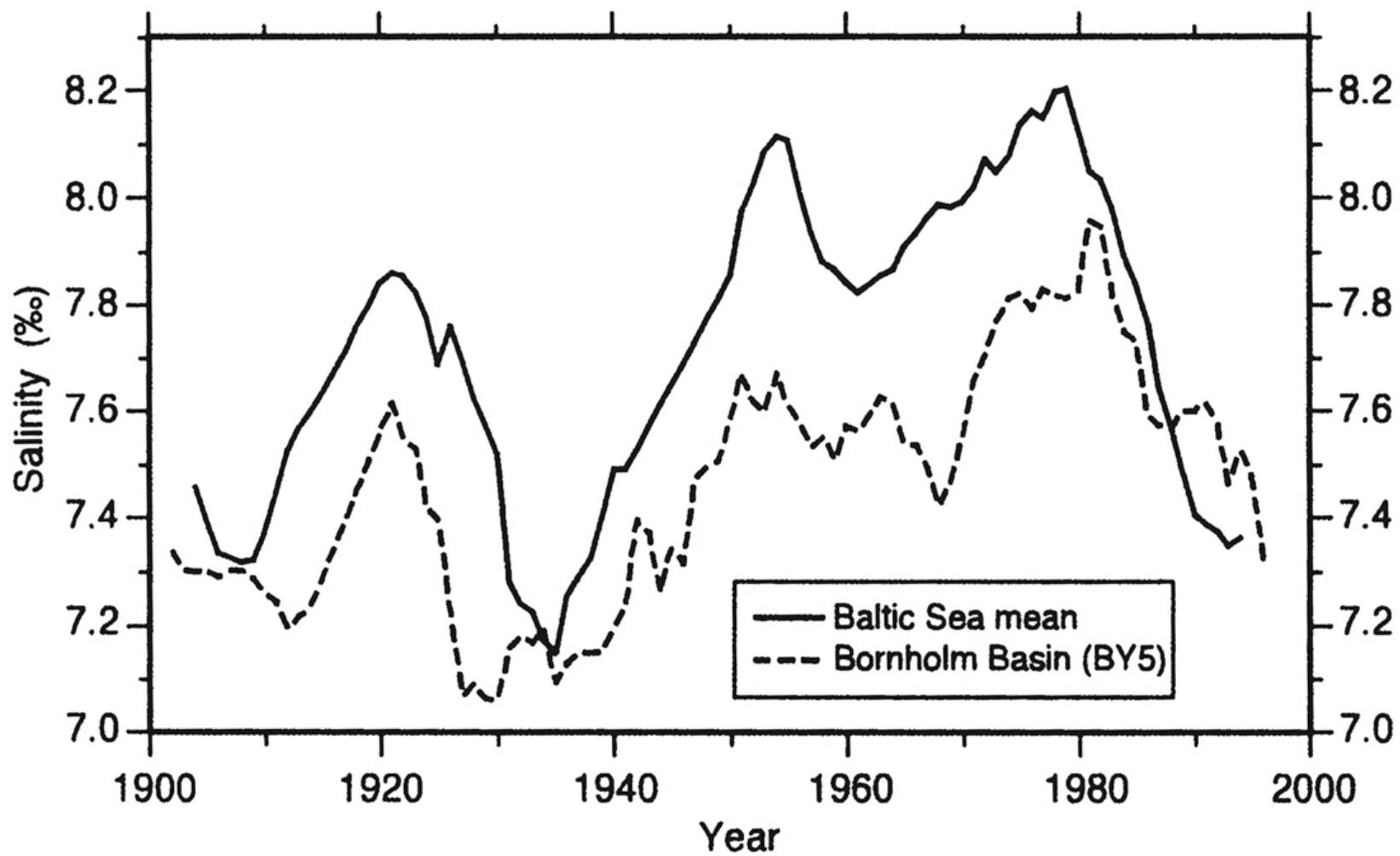
Anomaly time series of annual precipitation over Sweden, 1860-2004 (reference period 1961-90).

Precipitation



Number of low pressure systems ( $p < 980$  hPa)  
in Stockholm and Lund

Storminess



salinity



# Ongoing changes in regional ecosystems

- Associated changes in terrestrial ecosystems include
  - earlier spring phenological phase,
  - northward species shift, and
  - increased growth and vigour of vegetation.
- Robust assessments of changes in marine ecosystems related to climate change are hardly possible at this time. Further research is needed to discriminate between climate change and other anthropogenic drivers such as over-fishing, eutrophication, air pollution and land use changes.

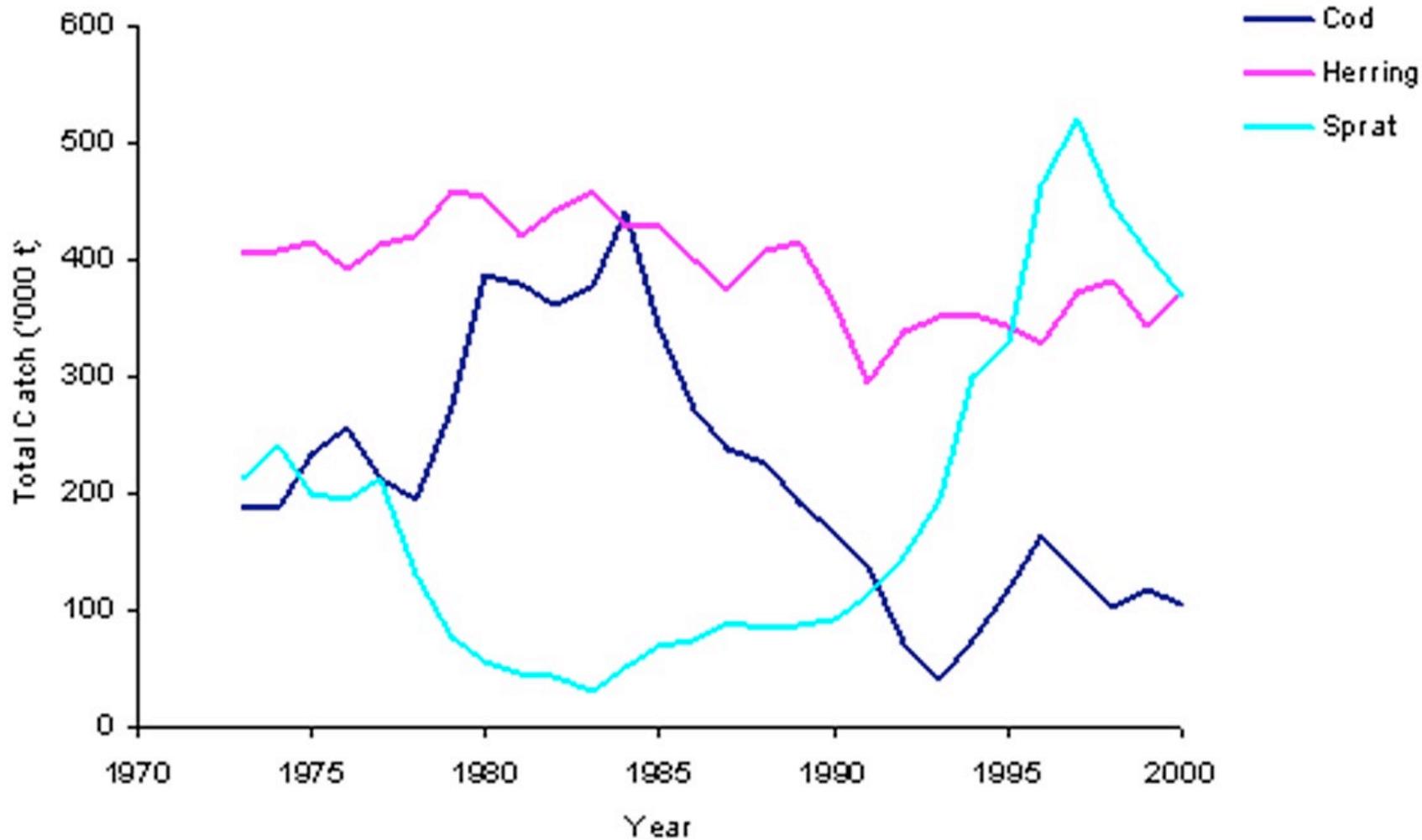


# Terrestrial ecosystems



Mean rate of change (days/year) of date of leaf unfolding in birch, 1958-2000

# Marine Ecosystems: Regime Shift in about 1988?





# Caveats

- Link to raising greenhouse gas concentrations is plausible, but no robust regional attribution has been established. (On the global scale this link has been established)
- Many conclusions relate to different time periods studied, changes occur at different time scales: Variability versus trend problem.
- Only few observational records span the entire recent 150 to 200 years.
- Changing observational techniques influence data homogeneity.
- "Detection and attribution" studies at the regional scale are urgently needed to determine the influence of anthropogenic factors in changing the regional climate.



# Scenarios of future climate ...

- ... constructed by feeding assumed emissions of greenhouse gases and aerosols into quasi-realistic models of the climate system.
- Future emissions can not be predicted; only plausible and consistent visions of the future (i.e., **scenarios**) are possible.
- Scenarios provide a frame for decision makers to explore the range of policy options to deal with the reality of anthropogenic climate change.
- **Scenarios are no predictions.**

# Scenarios of future climate change



- **Global** climate models (GCMs) project warming over the Baltic Sea basin.
- **Regional** scenarios are constructed from regional climate modelling, which provides more geographical detail and is broadly consistent with GCM projections.
- Results from regional climate modelling do not fully reflect model and scenario uncertainties.
- Within these limits, these results give an indication of plausible future changes by the end of the 21<sup>st</sup> century.

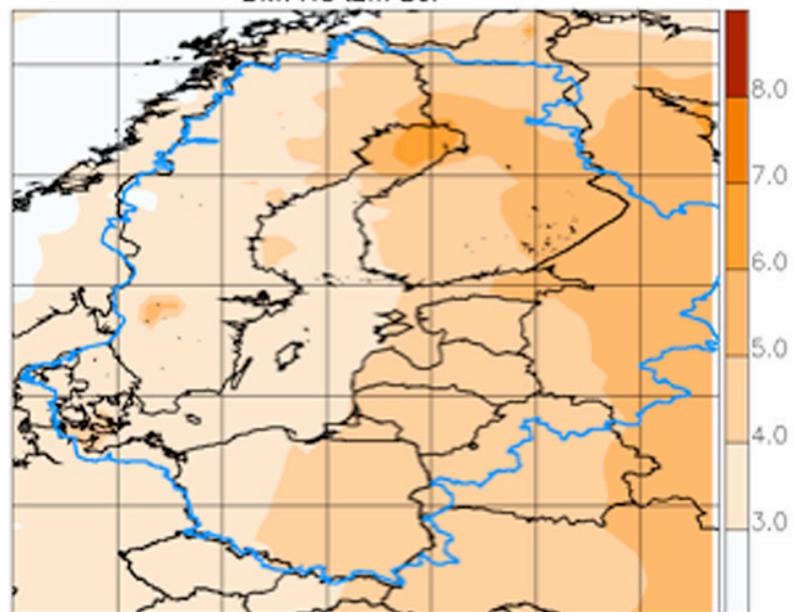


# Projections of future **regional** climate change

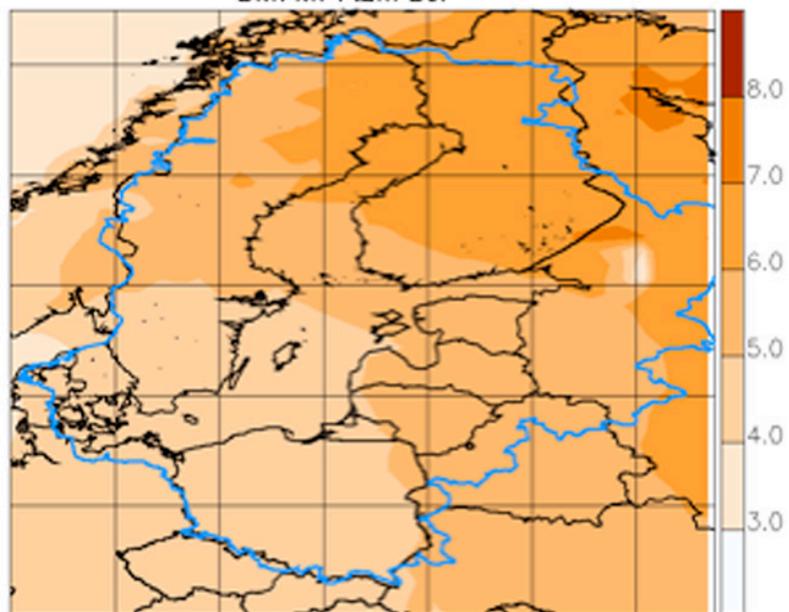
- Increasing temperatures very likely during the entire 21st century, but size of the trend depends considerably on model.
- Projected mean precipitation increases, largest increase in winter throughout the basin and decrease in summer in the southern basin.
- No clear projection for wind speed and storms.



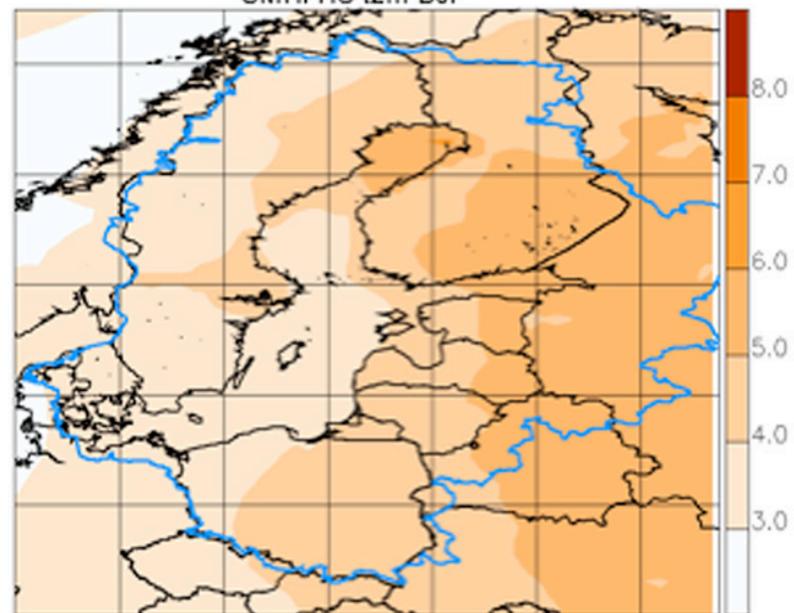
DMI HC t2m DJF



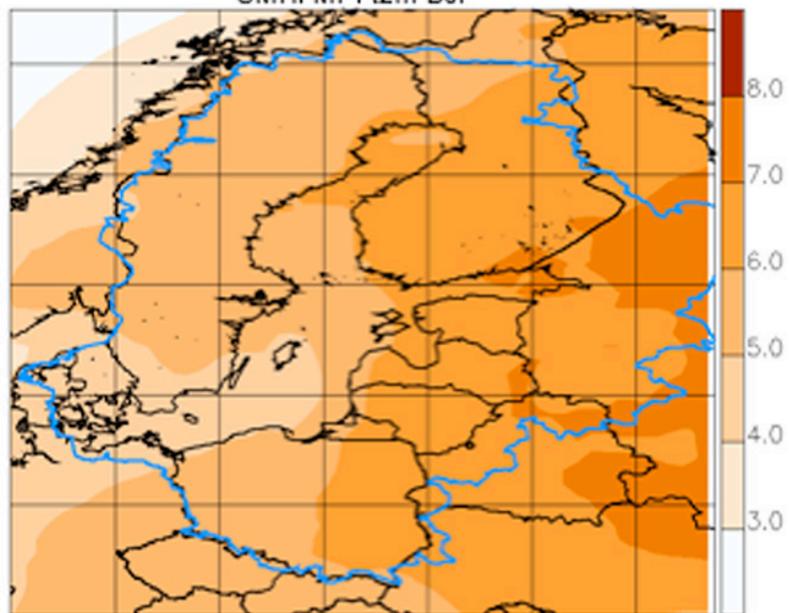
DMI MPI t2m DJF

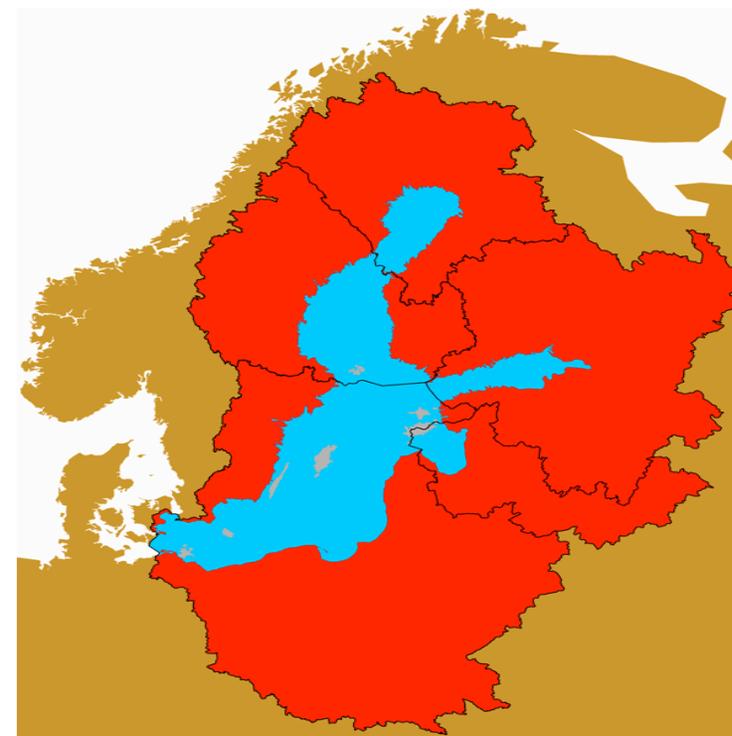
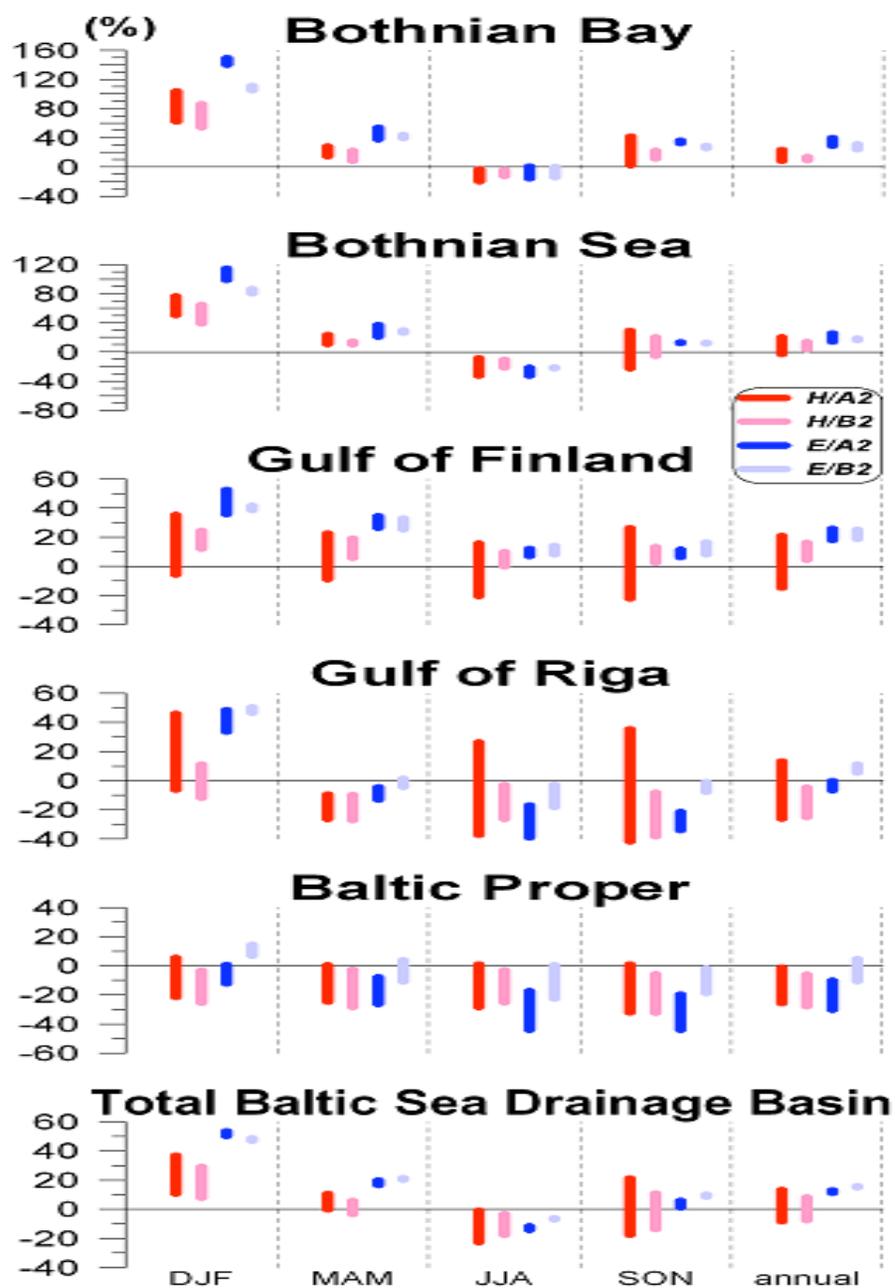


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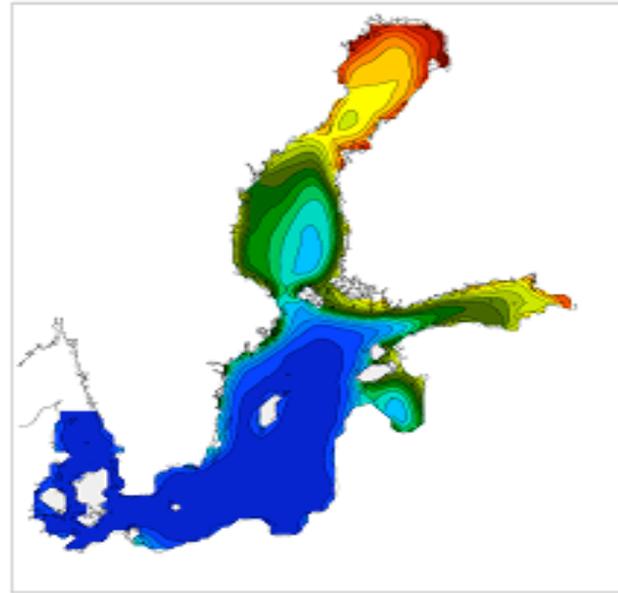


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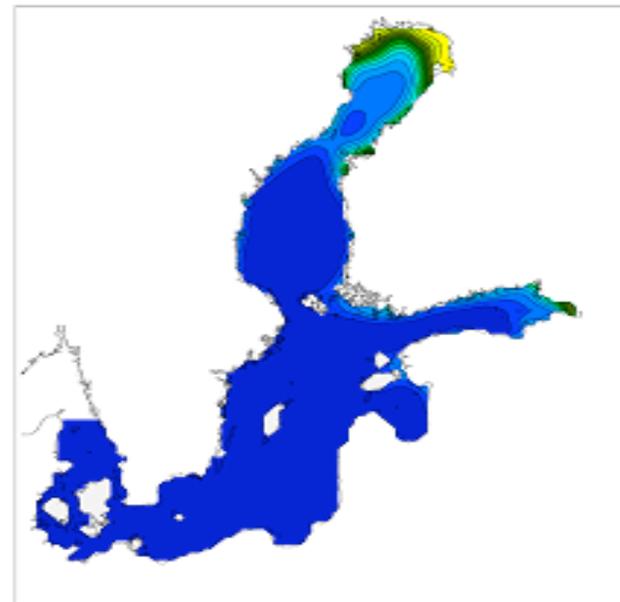
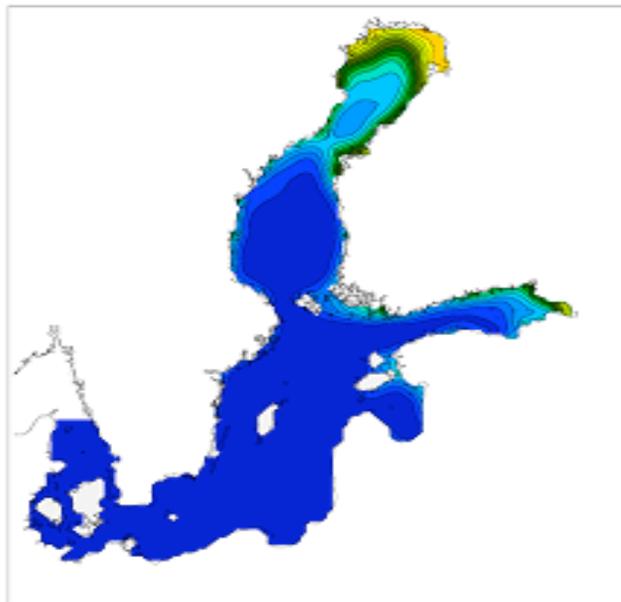




Percent volume change from 1960-1990 conditions) in river discharge in different scenarios for 2070-2100



Mean number of ice days in a present day simulation (top) and two scenarios of 2070-2100 (bottom)

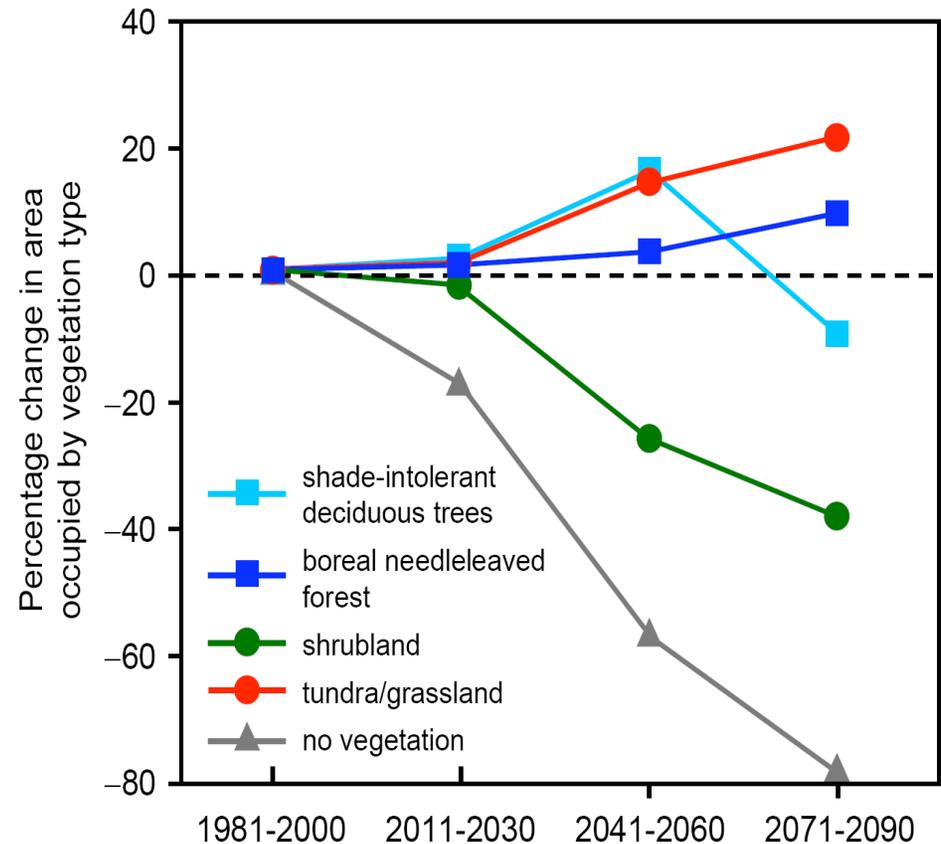


# Projections of future climate impacts on terrestrial ecosystems



The expected future warming is associated to a possibly accelerated continuation of the present trends in

- earlier spring phenological phases,
- northward species shifts and
- increased growth and vigour of vegetation



changes in the relative cover of different vegetation types in Northern Europe

# Projections of future climate impacts on marine ecosystems



- No detailed, comprehensive analysis available -projections are more ad-hoc and uncertain.
- Effect of other changing influences hardly predictable.
- Possible Baltic Sea salinity decrease would have major effect on marine fauna.
- Expected changes in precipitation and river runoff may have additional detrimental effects on the problem of eutrophication.



# Marine ecosystems

## - expected consequences of ...

... increase of temperature

- Higher metabolic rates
- Impact on acclimation capacity
- Reduce the general fitness
- Reduce enzyme activities
- Shift in species composition (phytoplankton)
- Enhanced cyanobacteria blooms



# Marine ecosystems

## - expected consequences of ...

... reduction in sea ice

- Ringed seal survival

... decrease of salinity

- Osmotic stress
- Shift in species composition (phyto- & zooplankton)
- Egg survival
- Food quality for fish (growth rate)
- Distribution of benthos
- Reduction of fitness
- Invading species

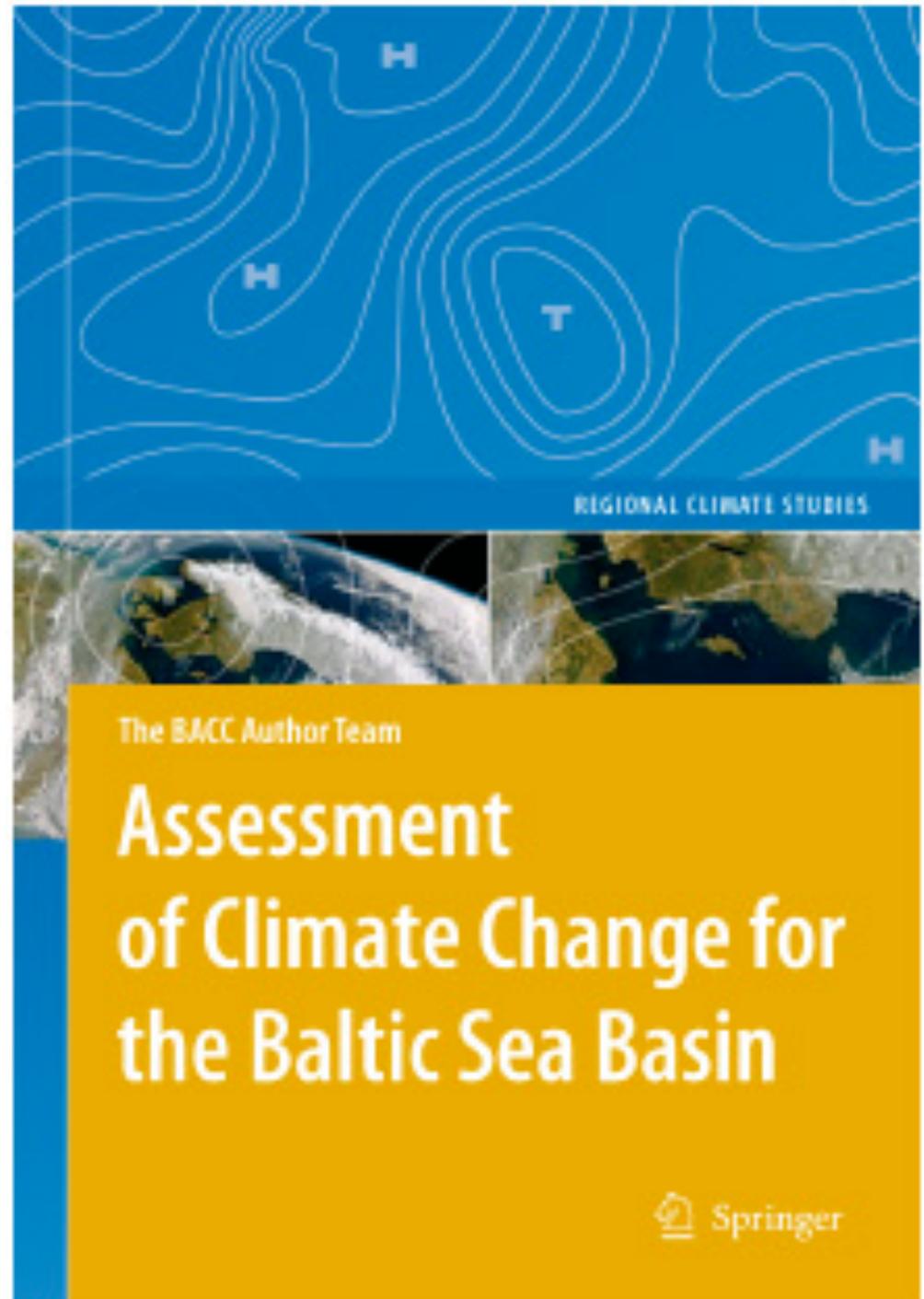


# In short ...

- Presently a warming is going on in the Baltic Sea region.
- BACC considers it plausible that this warming is at least partly related to anthropogenic factors.
- So far, and in the next few decades, the signal is limited to temperature and directly related variables, such as ice conditions.
- Later, changes in the water cycle are expected to become obvious.
- This regional warming will have a variety of effects on terrestrial and marine ecosystems - some predictable such as the changes in the phenology others so far hardly predictable.

# BACC book @ Springer

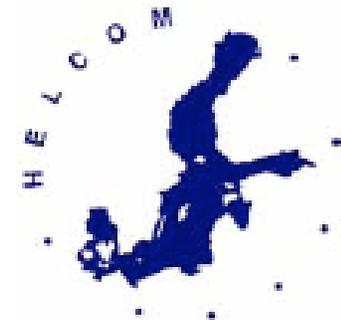
- ✓ The BACC assessment has been published in January 2008 in a peer-reviewed book on the published knowledge about climate change in the Baltic Sea region.
- ✓ Chapters:
  - 1) **Introduction and Policy Advise**
  - 2) **Past and Current Climate Change**
  - 3) **Projections of Future Climate**
  - 4) **Climate-related Change in Terrestrial and Freshwater Ecosystems**
  - 5) **Climate-related Change in Marine Ecosystems**



# BACC: HELCOM analysis



- BACC report officially accepted by HELCOM board as basis for further for analysis in March 2007.
- Based upon the BACC review HELCOM has prepared its own analysis of recent, ongoing and future climate change in the Baltic Sea region - and the implications for environmental politics.





# BALTEX: BACC and beyond

A BALTEX working group "BACC II" has been set up. It deals with the issue of BALTEX science objective 2 „climate and variability“

- based on the BACC approach of 5 chapters.
- organizing exchange of knowledge gains;
- defining protocols for parallel analysis;
- assessing state of knowledge;
- identifying gaps in knowledge;
- identifying potentials for extending the regional Earth system approach for the Baltic Sea catchment.



## Terms of references for BACC II

The work on BALTEX Assessment of Climate Change (BACC) should continue and be organised through a working group aiming for a new assessment within 5 years. The work should be lead by a BACC science steering group with the following terms of references:

- Report on what we have learned from BACC and how the book was received by different communities. Time: Dead line: Autumn 2008
- To increase our multi-disciplinary understanding by initiating a summer school on main drivers (climate, eutrophication, fishing, shipping, land use change, economic growth etc) and response characteristics in the Baltic Basin. Dead line: Summer 2009
- Organize a workshop for starting up the new assessment and for identifying new lead authors. Dead line: 2009/2010
- Organize the BACC II assessment aiming for a new book to be published 2012.

The "old" BACC Scientific Steering Group is terminated with the publication of the BACC book.



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- Sirje Keevalik
- Anders Omstedt
- Timo Vihma
- Representative of HELCOM
- More to be appointed (somebody from Poland, among others)